

Scanimation in the Analog Days

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Before the days of digital computers, calculations were done with analog circuitry. Instead of typing commands, you wired things together and adjusted knobs. When digital computers came along, graphics developers delighted in the ability to make trillions of precise computations, resulting in the very clean imagery we've come to associate with modern 3D graphics.

Only recently have the fastest modern computers with highly optimized software and hardware pipelines become capable of calculating and simultaneously displaying a complex sequence of animation in real time. But 20 years ago, it was just this ability that made the dozen or so Scanimate computers a unique milestone in the history of computer graphics.

My first experience with Scanimate was in 1979 when I went to work for Image West, Ltd. in Hollywood, CA. My background had been in video engineering, but because I had some computer experience, I was hired to maintain the studio's facilities, which included two Scanimate computers. There was only a single set of schematics, and a great deal of folklore associated with how the system worked. The animators essentially had to be analog design engineers, because they had to literally wire each animation together. But few of the animators actually had that kind of background. They were an interesting mix of technicians and creative geniuses that understood the subtleties of color and motion that gave the work its real value.

Scanimate was the brainchild of Lee Harrison III, founder of Computer Image, in Denver, CO. The earliest Scanimate blueprints date back to 1969, when it was a two-rack unit system.

Over the years, additional modules and racks were added to allow more functions and flexibility. In its heyday, the late '70s and early '80s, Scanimates were in operation in Japan, Australia, Luxembourg, London, New York, Hollywood and Denver.

The Scanimate process started with backlit light tables, which had animation pegs onto which high-contrast artwork was mounted. These were scanned by a progressive scan monochrome camera which ran at the NTSC or PAL field rate and about twice the horizontal rate.

This image was displayed on a five inch precision monochrome CRT using deflection signals generated by an analog CPU. All of the functions producing the scan for the CRT were programmable with voltages, and available at various patch panels on the front of the Scanimate. This gave Scanimate the appearance of some early music synthesizers with their maze of patch cords, function blocks and knobs.

The animator would patch together a series of ramp, sine/cosine generators, bias and gain potentiometers and multipliers and summing amplifiers to produce an animated sequence on the CRT. A single sequence button would start the animation either manually or on cue from a

SMPTE time code comparison from videotape. As the animation ran, the hundreds of knobs could be adjusted, resulting in immediate modifications of the end product. It was not unusual in the space of 60 seconds, to observe an animator running and rerunning a sequence dozens of times, while tweaking a handful of parameters until the whole animation behaved as desired.

The Scanimate was designed to run in either a film or video mode. The film mode allowed the camera to be run at real-time rates (24 frames per second), or for the shutter to be opened and closed with signals from a sequencer in order to perform streak photography. One of the most famous Scanimate-generated film sequences was a brief false-color image of the Death Star emerging from behind a planet in the first Star Wars film.

In Scanimate's video mode, the CRT displaying the animation was rescanned by a monochrome camera running at NTSC or PAL video rates. This camera fed an analog colorizer, which implemented a smooth mapping of gray scale values into colors. Scanimate's output was colorful, extremely smooth moving and surprisingly flexible and diverse in the variety of its effects. Dolphin Productions in New York City produced a lot of this type of Scanimation that appeared on PBS's Sesame Street and The Electric Company.

Scanimate's video mode was generally of more interest than the film mode because clients could bring in a logo, have it animated, interact with the animator programming the Scanimate, get exactly what they wanted and walk out a few hours later with a finished product ready for air. In the late '70s and early '80s, most animation was either hand drawn or done painstakingly with stop-motion streak techniques. This real-time capability was unheard of, and was even incorporated live in the 1978 Grammy Awards presentation.

Computer Image had developed the Scanimates and had attracted various investors, including the Smothers Brothers, who used some of its imagery on their television show. I'm told that at one point Beatle Ringo Starr was on a plane to Denver ready to buy a Scanimate, but another British businessman beat him to it by a couple of hours. By the mid-70s, a variety of customers had discovered the capabilities of Scanimate, and would fly to Denver to do work at the Computer Image Studios.

In 1977, Computer Image decided it could find a larger market by having a facility in Hollywood, so it borrowed heavily and set up a new company, Image West, Ltd. at 845 N. Highland Avenue. I'm told that the company, while very good technically, did not know the Hollywood market well, and was eventually foreclosed by its bank. The bank then approached Computer Image's largest customer, the Canadian Omnibus, Inc. and offered to have them take over Image West. Omnibus agreed, and operated the company until 1982 when it sold Image West and went on to form Omnibus Computer Graphics Inc., using digital technology licensed from the New York Institute of Technology. Image West continued to operate Scanimates until 1986 when it discontinued operations.

Analog computers tend to have problems with drift, noise and less precision than their digital counterparts. For the Scanimates, this meant that their interactivity remained unparalleled, but the image quality obtained by rescanning raster images could not stand up to the clean digital

images that were being calculated ever more rapidly using digital computers and frame buffer technology.

Scanimate also suffered from a total lack of repeatability. A typical animation might use a hundred or so patch cords, and require extremely precise adjustment of an equal number of knobs, each of which had nearly an infinite number of possible settings. Often a client returning with yesterday's finished product just needed one tiny thing to be tweaked slightly differently. When this happened, it usually required more time than had gone into the original animation and generally resulted in an animation that barely resembled the previous work.

But analog technology can do some amazing things in real time. I recall seeing a demonstration videotape in which a man wore a harness equipped with motion sensors connected to a Scanimate. Each sensor was a goniometer, a type of rotary transformer which converts angular displacement into a corresponding phase shift between windings. The wearer of this harness could cause a stick figure, generated by Scanimate, to mimic his movements in real time. Remember, this was done back in the early '70s, well before any of the recent magnetic or optical motion capture work.

The training of animators was a very difficult issue. Animator trainees kept notebooks of patch schematics and knob settings for starfields, spaghetti wipes, 3D-like animated oscillograms and all the arsenal of effects they were expected to be able to wire up and tweak into place in just a few minutes time. Typically, an animator would work in conjunction with a designer, a sales rep and, of course, the client, who paid as much as \$1,500 per hour for the Scanimate experience.

The designer would develop the artwork, either high-contrast Kodalith logotypography or actual airbrushed artwork that was scanned by a color studio camera. One of my projects involved applying motion control capabilities to a studio camera's pan, tilt and zoom so that it could be controlled by and synchronized with the Scanimate. Occasionally, actual three-dimensional block lettering models would be built and mounted on a motion control rig in the studio. These would be combined with the Scanimate imagery with blue or green-screen matting techniques.

The jobs were built in passes, each requiring a generation loss on analog videotape. IVC-9000 2" helical video recorders were used, and I was amazed at the number of generations the animators would get away with using, while still maintaining reasonable image quality and meeting broadcast standards. The design of the overall job was crucial, since the layers had to be built from back to front in a tree structure. This meant that you only saw the finished product when you got to the last composite, so you had to have meticulous logs with SMPTE timecode and notes for each pass in order to know where to go when it became necessary to redo any of the elements.

Computer Image went on to develop a system called CAESAR, which stood for Computer Animated Events with Single Axis Rotation. CAESAR was targeted at moving cartoon characters' limbs in an attempt to automate the Saturday morning cartoon production process. CAESAR used most of Scanimate's analog processing technology with digital parameter storage on a Data General minicomputer. CAESAR was never mass produced to my knowledge. A later product, System V was produced, with an improved digital computer, and it replaced Scanimate

in several facilities. While at Image West, I also worked on development of a hybrid analog/digital system called VersEFx. But ultimately, the analog image quality produced by such CRT rescan systems could not compete with that of totally digital systems.

In 1993, I got a phone call from Roy Weinstock, with whom I had worked at Image West. Roy was working at Interface Video in Washington, D.C. Interface had obtained the original R&D Scanimate from Computer Image in Denver. Interface was preparing to decommission the machine and Roy asked if I wanted it. I drove a truck to Interface and hauled the machine back to my basement in Kingsport, TN, where I reconnected, repaired and coaxed the machine into working condition again.

I have since set up a Web site about Scanimate at: <http://scanimate.zfx.com>. Over the past year or so, it has been visited by thousands of people from all over the world, and many people who have worked with Scanimate at various companies have left their postings on a discussion board there. I urge you to visit the Web site.

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